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APPLICATION NUMBER: *60/400,865*
FILING DATE: *August 01, 2002*

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08/01/02 C759 U.S. PTO

J1036 U.S. PTO 60/400865 08/01/02

PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No.	EL821235785US

INVENTOR(S)

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☑ *Additional inventors are being named on the* 1 *separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

SYSTEM AND METHOD OF WIRELESS ALWAYS-ON INTERNET PROTOCOL COMMUNICATION

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

☐ Customer Number [ ] *Type Customer Number here* → *Place Customer Number Bar Code Label here*

OR

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ENCLOSED APPLICATION PARTS ***(check all that apply)***

☑ Specification *Number of Pages*	8	☐ CD(s), Number	
☑ Drawing(s) *Number of Sheets*		☑ Other (specify)	Appendix (7 pgs.)
☐ Application Data Sheet. See 37 CFR 1.76			

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

☐ Applicant claims small entity status. See 37 CFR 1.27.
☐ A check or money order is enclosed to cover the filing fees
☑ The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 501432
☐ Payment by credit card. Form PTO-2038 is attached.

FILING FEE AMOUNT ($): $160.00

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.
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☐ Yes, the name of the U.S. Government agency and the Government contract number are: ____________

Respectfully submitted,

SIGNATURE John V. Biernacki

Date 08/01/2002

TYPED or PRINTED NAME John V. Biernacki

REGISTRATION NO. *(if appropriate)* 40,511

Docket Number: 555255012324

TELEPHONE 216-586-7747

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

[redacted]

PROVISIONAL APPLICATION COVER SHEET
Additional Page

Docket Number	555255012324

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Number 1 of 1

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60430345 .080102

FEE TRANSMITTAL for FY 2002

Patent fees are subject to annual revision.

TOTAL AMOUNT OF PAYMENT ($) 160.00

Complete if Known	
Application Number	
Filing Date	
First Named Inventor	Xue et al.
Examiner Name	
Group Art Unit	
Attorney Docket No.	555255012324

METHOD OF PAYMENT

1. ☑ The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to

Deposit Account Number: 501432

Deposit Account Name: Jones, Day, Reavis & Pogue

☐ Charge Any Additional Fee Required Under 37 CFR 1 16 and 1 17

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FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	740	201	370	Utility filing fee	
106	330	206	165	Design filing fee	
107	510	207	255	Plant filing fee	
108	740	208	370	Reissue filing fee	
114	160	214	80	Provisional filing fee	160 00

SUBTOTAL (1) ($) 160.00

2. EXTRA CLAIM FEES

			Extra Claims		Fee from below		Fee Paid
Total Claims		-20** =		X		=	
Independent Claims		- 3** =		X		=	
Multiple Dependent						=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	84	202	42	Independent claims in excess of 3
104	280	204	140	Multiple dependent claim, if not paid
109	84	209	42	** Reissue independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($)

***or number previously paid, if greater; For Reissues, see above*

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for *ex parte* reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	400	216	200	Extension for reply within second month	
117	920	217	460	Extension for reply within third month	
118	1,440	218	720	Extension for reply within fourth month	
128	1,960	228	980	Extension for reply within fifth month	
119	320	219	160	Notice of Appeal	
120	320	220	160	Filing a brief in support of an appeal	
121	280	221	140	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,280	241	640	Petition to revive - unintentional	
142	1,280	242	640	Utility issue fee (or reissue)	
143	460	243	230	Design issue fee	
144	620	244	310	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Processing fee under 37 CFR 1.17(q)	
126	180	126	180	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	740	246	370	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	740	249	370	For each additional invention to be examined (37 CFR § 1.129(b))	
179	740	279	370	Request for Continued Examination (RCE)	
169	900	169	900	Request for expedited examination of a design application	

Other fee (specify) ____________

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($)

SUBMITTED BY				Complete *(if applicable)*	
Name (Print/Type)	John V. Biernacki	*Registration No. (Attorney/Agent)*	40,511	*Telephone*	216-586-7747
Signature	John V. Biernacki			*Date*	08/01/2002

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Title: System and method of wireless always-on Internet protocol communication

Inventors: Hao Xue, Dan Willey, Khaled Islam, & Shahid Chaudry

Assignee: Research In Motion Limited

Field of Invention

The present invention is directed towards the field of point-to-point communication techniques. In particular, the present invention relates to the field of wireless always-on Internet protocol communication.

Related Art

A presently known technique of wireless IP communications that utilizes link control protocols is TIA/EIA/IS-835-A (PN-3-4732-RV2-A currently being re-balloted in TR45.6), which is incorporated herein by reference. This technique may be an unacceptable solution as it may waste resources of the air interface and curtail the mobile station battery life, particularly in out-of-coverage or similar situations where it is typical that a link control session does not remain operable.

RFC 1661 specifies a link control protocol, point-to-point protocol (PPP), which is incorporated herein by reference. Certain aspects of PPP, such as LCP Echo-Requests and Echo-Reply, may not be optimized for wireless communication, as many data fields in PPP, when sent over the air, are un-interpreted and therefore may waste resources of the air interface and curtail the mobile station battery life.

There remains a need for a robust technique of wireless always-on IP communication that remains operable in an out-of-coverage or similar situation.

Summary of Invention

It is an object of the present invention to obviate or mitigate at least one disadvantage of previous wireless IP techniques. It is a further object of the present invention to provide a system and method of wireless always-on Internet protocol communication that is robust against out-of-coverage and like situations, and which systematically provides reliable communications.

According to a first aspect of the present invention, a wireless system having always-on components is provided. The always-on components enable always-on wireless Internet Protocol (IP) communications.

According to a second aspect of the present invention, an always-on method carried out in various always-on components is provided. The always-on method enables always-on wireless Internet Protocol (IP) communications at those components that carry out the method.

Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying FIGS..

Brief description of the Drawing

Embodiments of the present invention will now be described, by way of example only, with reference to the attached FIGS., wherein:

FIG. 1 shows one embodiment of a system for wireless always-on IP communication;

FIG. 2 shows the protocol stacks at various components of the system of FIG. 1;

FIG. 3 shows details of one embodiment of the always-on MS of FIGS. 1 and 2;

FIG. 4 shows details of one embodiment of the always-on PDSN of FIGS. 1 and 2;

FIG. 5 shows one embodiment of a method of initiating PPP at an always-on MS;

FIG. 6 shows a first embodiment of a method of maintaining synchronization of PPP in an always-on MS;

FIG. 7 shows a second embodiment of a method of maintaining synchronization of PPP in an always-on MS.; and

FIG. 8 shows one embodiment of method in a PDSN for maintaining synchronization of PPP for always-on MSs.

Detailed Description

According to a first aspect of the present invention, a wireless system having always-on components is provided. The always-on components enable always-on wireless Internet Protocol (IP) communications.

Referring to FIG. 1, FIG. 1 shows one embodiment of a system for wireless always-on IP communication, which will be described presently. An always-on mobile station (MS) 10 communicates over an Internet Protocol (IP) Network 30 with an end host 40 via at least one always-on access provider network (APN) cooperating with back-end infrastructure. Always-on MS 10 communicates with a first always-on visiting APN 20V, and then is handed-off to a second always-on serving APN 20S. The always-on serving APN 20S communicates to back-end infrastructure including a home APN 60, a home IP network 70, and a broker network 80. Alternatively, the always-on MS 10 could communicate with back-end infrastructure directly via always-on serving APN 20S.

Both the always-on serving and visiting APNs 20S,20V include known components such as a radio network (RN) 22S,22V. As illustrated in the case of the serving APN 20S, known components include mobile switching center (MSC) 23S which connects the source RN 22S with a home location register (HLR) 62 at the home APN 60 via signaling system 7 (SS7) network 50. Also known is serving remote authentication dial in service (RADIUS) 24S that communicates with corresponding RADIUS components home RADIUS 74 and broker RADIUS 84 in the home IP network 70 and broker network 80 respectively.

Also known are the home IP network 70 and broker network 80, which are typically accessible over the same IP network 30 on which resides the end host 40. IP network can be any network, such as the Internet or a private IP network or an intranet.

Further details on the operation of these known components can be found in TIA/EIA/IS-2000-1, TIA/EIA/IS-2000-2, TIA/EIA/IS-2000-3, TIA/EIA/IS-2000-4, TIA/EIA/IS-2000-5, 3GPP2 C.S0001, 3GPP2 C.S0002, 3GPP2 C.S0003, 3GPP2 C.S0004, 3GPP2 C.S0005, TIA/EIA/IS-707, 3GPP2 C.S0017, and their revisions, which are incorporated herein by reference.

In addition to known components in the always-on APN 20S, an always-on serving packet data serving node (PDSN) 25S is also shown. The always-on serving PDSN 25S co-operates with the always-on MS 10 via an always-on target PDSN 25V at the always-on visiting APN 20V.

In alternate embodiments of the first aspect, APNs 20S and 20V need not both be of the always-on variety, but rather it is sufficient that at least one APN which communicates with always-on MS 10 be of an always-on type, the always-on MS and always-on APN both provided in accordance with the present invention. Further details of the always-on MS 10 will be described with reference to FIGS. 2 and 3 below, whereas further details of always-on APN and always-on PDSN will be described with reference to FIGS. 2 and 4 below.

Turning now to FIG. 2, FIG. 2 shows the protocol stacks at various components of the system of FIG. 1, which will be described presently. Four protocol stacks 110,122,125 and 140 are illustrated, each corresponding respectively to always-on MS 10, RN 22, always-on PDSN 25 and end host 40 of FIG. 1 respectively. Stacks 110 and 125 include always-on PPP layers 115 and 130 respectively. Always-on PPP layers 115 and 130 co-operate to ensure that the PPP session which enables IP communication between the MS and the end host is maintained despite out-of-coverage or similar situations at the MS, such as for example due to the wireless air link between the MS and the RN. Further details of the operation of the always-on PPP layer 115 at the always-on MS will be described in reference to Fig. 3, whereas further details of the operation of the always-on PPP layer 135 at the always-on PDSN will be described in reference to Fig. 4

Referring now to FIG. 3, FIG. 3 shows details of one embodiment of the always-on MS of FIGS. 1 and 2. The always-on MS 310 includes a processor 320, a transceiver 322 as well as an always-on MS module 315 that keeps track of and operates based upon the value of a PPP inactivity timer estimate 330.

Other modules 340 include what is normally required to operate a MS, such as a screen and keyboard and/or speaker and microphone, etc.

Operationally, when the transceiver 322 of always-on MS 310 receives an always-on echo-request 350, the transceiver passes the request onto the processor 320, which then sends the data 355 to the always-on MS module. The data portion 355 includes a PPP inactivity timer value that is used by the always-on MS module 315 to set the PPP inactivity timer estimate. The value of the PPP inactivity timer estimate 330 in turn affects the operation of the always-on MS module 315, particularly in out-of-coverage situations that can be signaled to the always-on MS module by the transceiver 322, processor 320, and other modules 340. To maintain an always-on connection, the always-on module can, either exclusively or in combination, receive always-on echo-request 350, send echo-reply 360, send echo-request 370, receive echo-reply 380 or initiate PPP-session 390.

FIG. 4 shows details of one embodiment of the always-on PDSN of FIGS. 1 and 2. The always-on PDSN 425 includes a processor 420, a transceiver 422 as well as an always-on PDSN module 415 that keeps track of and operates based upon the value of a PPP inactivity timer 430. Other modules 440 include what is normally required to operate a PDSN, such as additional transceivers for various networks, etc.

Operationally, when the transceiver 422 and processor 420 detect PPP activity with an always-on MS, the always-on PDSN module 415 is notified of the activity and as such resets the PPP inactivity timer 430. At least once after a PPP session has been initiated for a MS, the value of the PPP inactivity timer 430 is sent to the always-on MS via an always-on echo-request 450 by the always-on PDSN module 415. The always-on echo request 450 includes the value of the PPP inactivity timer in the data field – which is normally un-interpreted according to RFC 1661. Other techniques are envisaged to send this value to the MS, what is desirable is that the MS has an accurate estimate of the PPP inactivity timer. Thus, whenever the maximum value of the timer changes, it is desirable to send the new value to the MS. PPP activity which causes the always-on PDSN module 415 to reset the PPP inactivity timer include either exclusively or in combination sending an always-on echo-request 450, receiving an echo reply 460, receiving an echo-request 470, sending an echo reply 480 and receiving an initiate PPP-session 490.

Having described the first aspect of the present invention, according to a second aspect of the present invention, an always-on method carried out in various always-on components is provided. The always-on method enables always-on wireless Internet Protocol (IP) communications at those components that carryout the method.

Referring to FIG. 5, FIG. 5 shows a method of initiating PPP at an always-on MS. Referring to FIG. 5, Step 500 shows the start; this step would happen, for example, when an always-on MS is powered on. In step 505 the MS initiates PPP. For example, the MS could initiate a call (for further details, the reader is referred to TIA/EIA/IS-2000-1, TIA/EIA/IS-2000-2, TIA/EIA/IS-2000-3, TIA/EIA/IS-2000-4, TIA/EIA/IS-2000-5 which have been incorporated herein by reference) using a packet data service option such as Service option 33 (for further details, the reader is referred to TIA/EIA/IS-707 which has incorporated herein by reference). The PDSN then initiates the PPP session to the MS. In Step 510, the

MS enters the IPCP Opened state. In step 515, the MS checks to see if it has received a message with a data field. Preferably the message is an LCP Echo-Request message sent by the PDSN. The data field could be received in other ways such as via an A-interface message in a new version of the A-interface sent from the PDSN to the RN and then to the MS via a message defined in a new version of IS-707. Using the LCP Echo-Request to carry the data field is preferred because it only requires a change to IS-835 and not to IS-707 and the A-interface. When the MS checks to see if it receives the message, it could allow a certain time period within which it would expect the message - 5 seconds, for example. If a message with the data field is received within this time period, processing continues in FIG. 6. If a message with the data field is not received within this time period, then processing continues in FIG. 7. The data field sent to the MS preferably contains the value of the PPP inactivity timer. Other information could also be sent via the data field. For example, the information on voice call handling

Turning to FIG. 6, FIG. 6 shows a method of maintaining synchronization of PPP in an always-on MS. The PPP inactivity timer is reset at step 600. For example, if the MS had received a value of 60 seconds for the PPP inactivity timer, it could set a timer to 60 and count down once per second such that it would expire if it reached zero. Processing continues at decision step 605. If there is PPP activity, then processing continues at step 600. If there is no PPP activity, then processing continues at step 610. PPP activity could be determined by receiving a PPP packet from the PDSN or by sending to the PDSN a PPP packet for which there has been acknowledgement. At decision step 610, the MS checks to see if there is a condition that makes it unreachable. Such a condition could be for example, a loss of the paging channel (see C.S0005-0-2 which has been incorporated herein by reference.) Another such condition could be when making a voice telephone call using a service option such as EVRC when the air interface does not support concurrent services. If there is no condition that makes the MS unreachable, processing continues at step 605. Otherwise, if there is a condition that makes the MS unreachable, processing continues at step 615. At decision step 615, the MS checks to see if it is again reachable. An example of the MS becoming reachable again would be if the MS reacquired the Paging Channel after a loss of the paging channel. Another example would be if the MS ended a voice telephone using a service option such as EVRC. If the result of decision step 615 is that the MS is not yet reachable, processing remains at decision step 615. If the result of decision step 615 is that the MS is reachable again, then processing continues at decision step 620. At decision step 620, the MS checks to see if the PPP inactivity timer has expired. If the check determines that the PPP inactivity timer has not expired, then processing continues at step 605. If the check determines that the PPP inactivity timer has expired, the processing continues at step 625. At step 625, the MS sends an LCP Echo-Request message to the PDSN. Processing continues at step 630. After the MS receives an LCP Echo-Reply from the PDNS in step 630, processing continues at step 600.

Turning now to FIG. 7, FIG. 7 shows a method of maintaining synchronization of PPP in an always-on MS. Processing begins at decision step 700. At decision step 700, the MS checks to see if there is a condition that makes it unreachable. Such a condition could be for example, a loss of the paging channel (see C.S0005-0-2.) Another such condition could be when making a voice telephone call using a

service option such as EVRC when the air interface does not support concurrent services. If there is no condition that makes the MS unreachable, processing continues at step 700. Otherwise, if there is a condition that makes the MS unreachable, processing continues at step 705. At decision step 705, the MS checks to see if it is again reachable. An example of the MS becoming reachable again would be if the MS reacquired the Paging Channel after a loss of the paging channel. Another example would be if the MS ended a voice telephone using a service option such as EVRC. If the result of decision step 705 is that the MS is not yet reachable, processing remains at decision step 705. If the result of decision step 705 is that the MS is reachable again, then processing continues at decision step 710. At step 710 the MS initiates PPP as in FIG. 5.

Referring now to FIG. 8, FIG. 8 shows an embodiment of method in a PDSN for maintaining synchronization of PPP for always-on MSs. In step 800 the PDSN initiates PPP. Processing then continues at step 805 where the PDSN enters the IPCP opened state (Internet Protocol Control Protocol opened state as described in RFC 1332 which hereby incorporated herein by reference), processing then continues at step 810 where the PDSN sends an LCP Echo-Request message including a Data field of non-zero length. The Data field contains the value of the PPP inactivity timer. Other information could be included in this Data field as well. The data field could be sent via other messages, but it is preferred to send it in an LCP Echo-Request. After sending a message with the Data field, processing continues at step 815. At 815 the PDSN starts (or resets) the PPP inactivity timer. For example, if the value of 60 seconds is used for the PPP inactivity timer, the PDSN could set a timer to 60 and count down once per second such that it would expire if it reached zero. After the PDSN starts the PPP inactivity timer processing continues at decision step 820. If there is PPP activity, then processing continues at step 815. If there is no PPP activity, then processing continues at step 825. PPP activity could be determined by receiving a PPP packet from the MS or by sending to the MS a PPP packet for which there has been acknowledgement. At decision step 825, the PDSN checks to see if the PPP inactivity timer has expired. If the check determines that the PPP inactivity timer has not expired, then processing continues at step 820. If the check determines that the PPP inactivity timer has expired, the processing continues at step 830. At step 830, the PDSN sends an LCP Echo-Request message to the MS. Processing continues at step 835. At step 835 the PDSN starts an Echo-Reply timer and also decrements the Echo-Request-Retries counter by one. Processing then continues at decision step 840. At decision step 840, the PDSN checks whether it has received an LCP Echo-Reply message, and LCP Echo-Request message, or any other PPP message from the MS. It should be noted that this differs from previous versions of the standard - in previous versions of the standard the PDSN only checked for an LCP Echo-Reply. Checking for the LCP Echo-Request allows the PDSN to take advantage of the Echo-Request being sent by the MS as shown in step 625 of FIG. 6. When the PDSN receives this message the result will be that the PPP inactivity timer is reset and the likelihood that PPP is released by the PDSN (causing an out-of-sync condition with the MS) is reduced. Furthermore, by checking for other PPP messages the PDSN would be able to reset the PPP inactivity timer even if neither an LCP Echo-Request nor an LCP Echo-Response is sent by the MS but if the MS sent any other PPP packet, thus further

reducing the probability of an out-of-sync condition with the MS. If the result of decision step 840 is that one of the above described messages was received, the processing continues at step 845. If the result of decision step 840 is that none of the above described messages was received, then processing continues at decision step 850. At step 845 the PDSN stops the Echo-Reply timer and then processing continues at step 815. At decision step 850, the PDSN checks to see if the Echo-Reply timer expired. If the Echo-Reply timer has not expired, processing continues at decision step 840. If the Echo-Reply timer has expired, processing continues at decision step 855. At decision step 855 the PDSN checks to see if the Echo-Request-Retries counter is greater than zero. If the counter is greater than zero, processing continues at step 830. If the counter is not greater than zero, then processing ends at step 860 where the PDSN releases PPP.

Although not expressly shown in the drawings, an alternate always-on APN including an always-on RN that cooperates with the always-on PDSN and always-on MS to treat voice calls as PPP activity is also envisaged. The always-on PDSN determines from the always-on RN that the always-on MS is currently in a voice call, and therefore that the MS is unreachable for the purposes of PPP communication. The always-on PDSN treats the always-on MS as if it were active for the purposes of PPP. A corresponding alternate embodiment of the always-on MS is also envisaged adapted to this functionality, the MS also treats the voice call as PPP activity.

Additional details regarding the embodiments of the present invention may be found in the appendices attached herewith and included herein.

The above-described embodiments of the present invention are intended to be examples only. Alterations, modifications and variations may be effected to the particular embodiments by those of skill in the art without departing from the scope of the invention.

ABSTRACT

A system and method of wireless always-on Internet protocol communication is disclosed herein. The disclosed method and system prevent the loss of connectivity to an end-host resulting from out-of-coverage situations and the like at a mobile station (MS). The disclosed method and system prevent wasted air-interface resources and improve battery life at a MS.

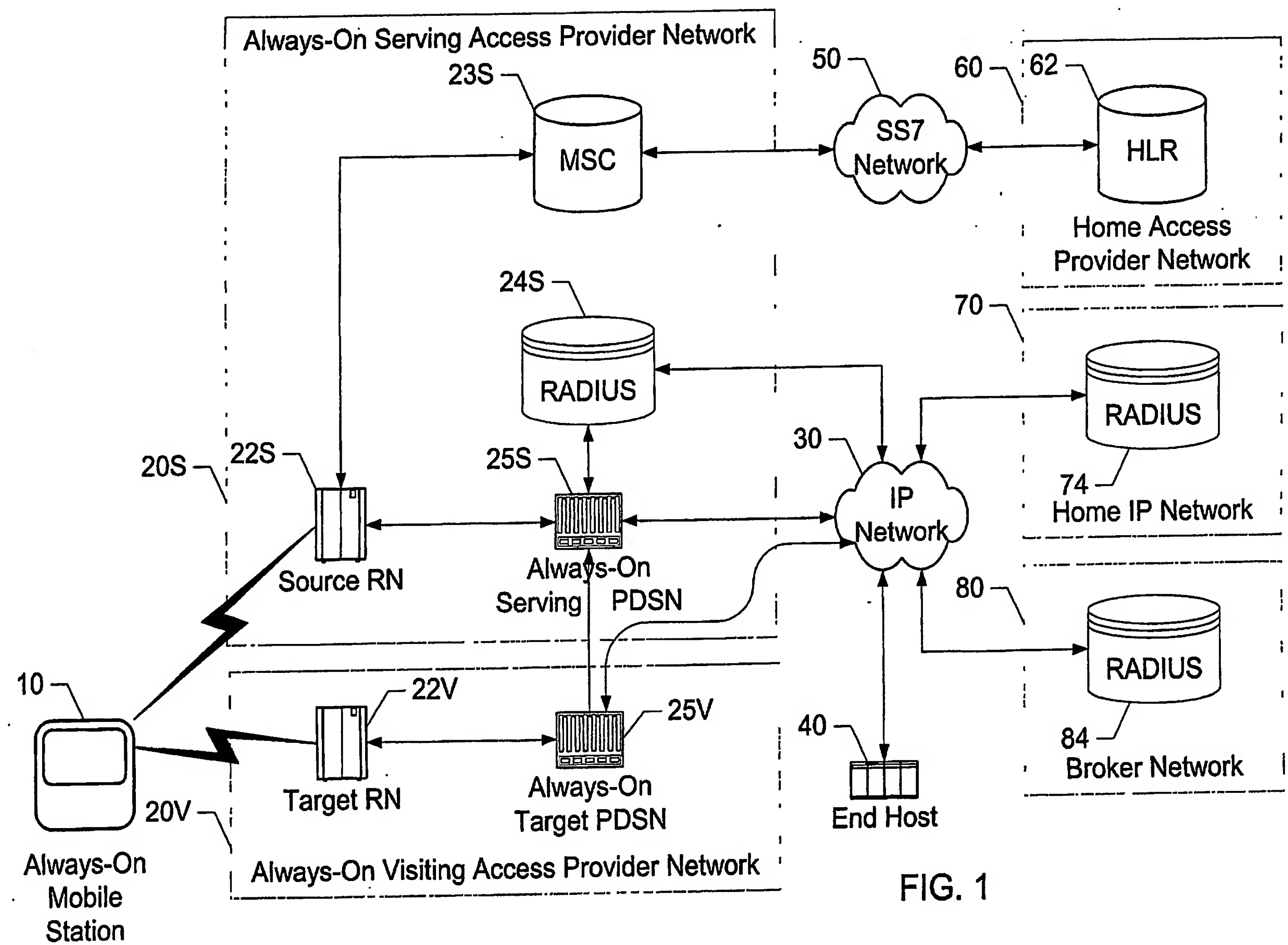

FIG. 1

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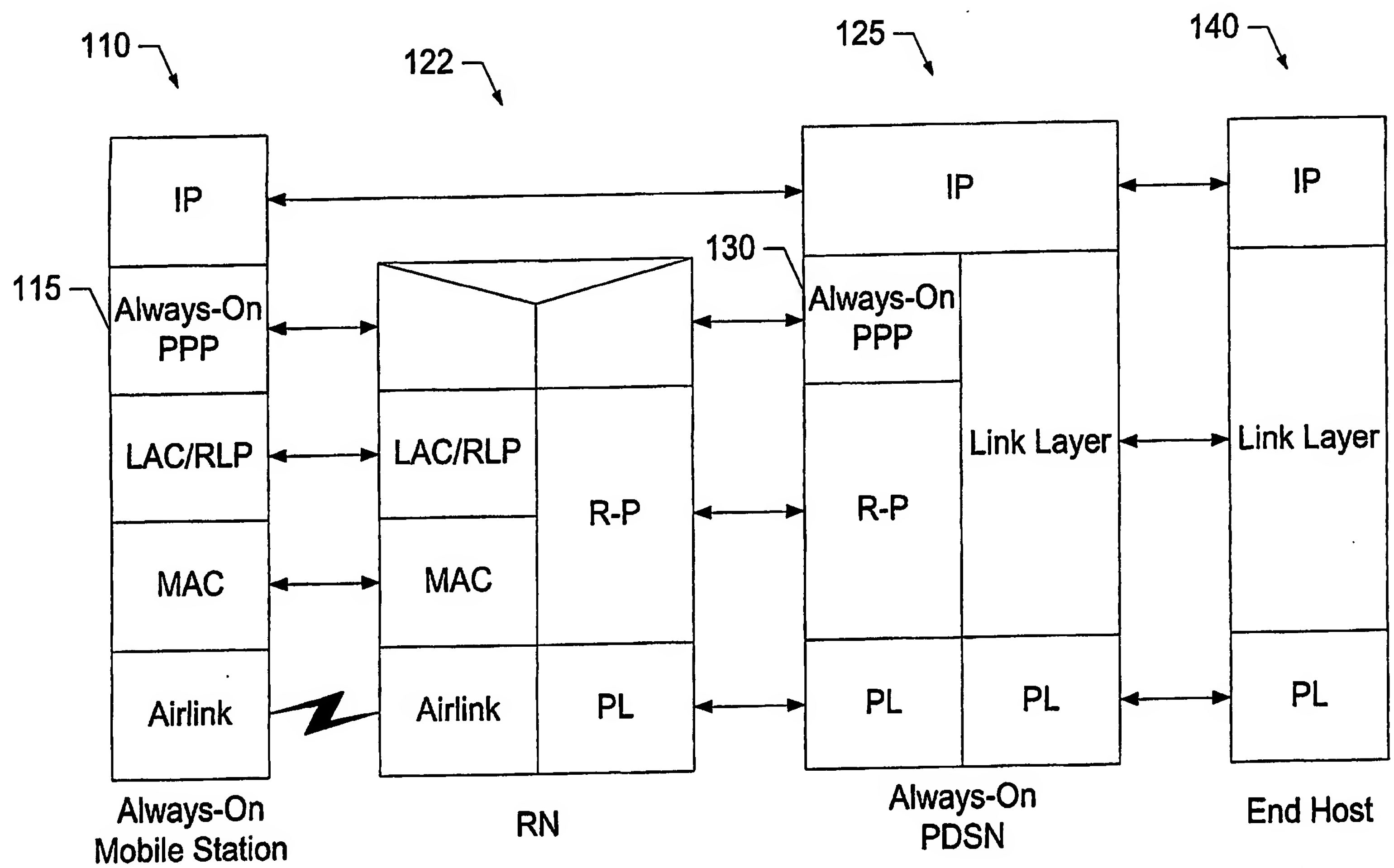


FIG. 2

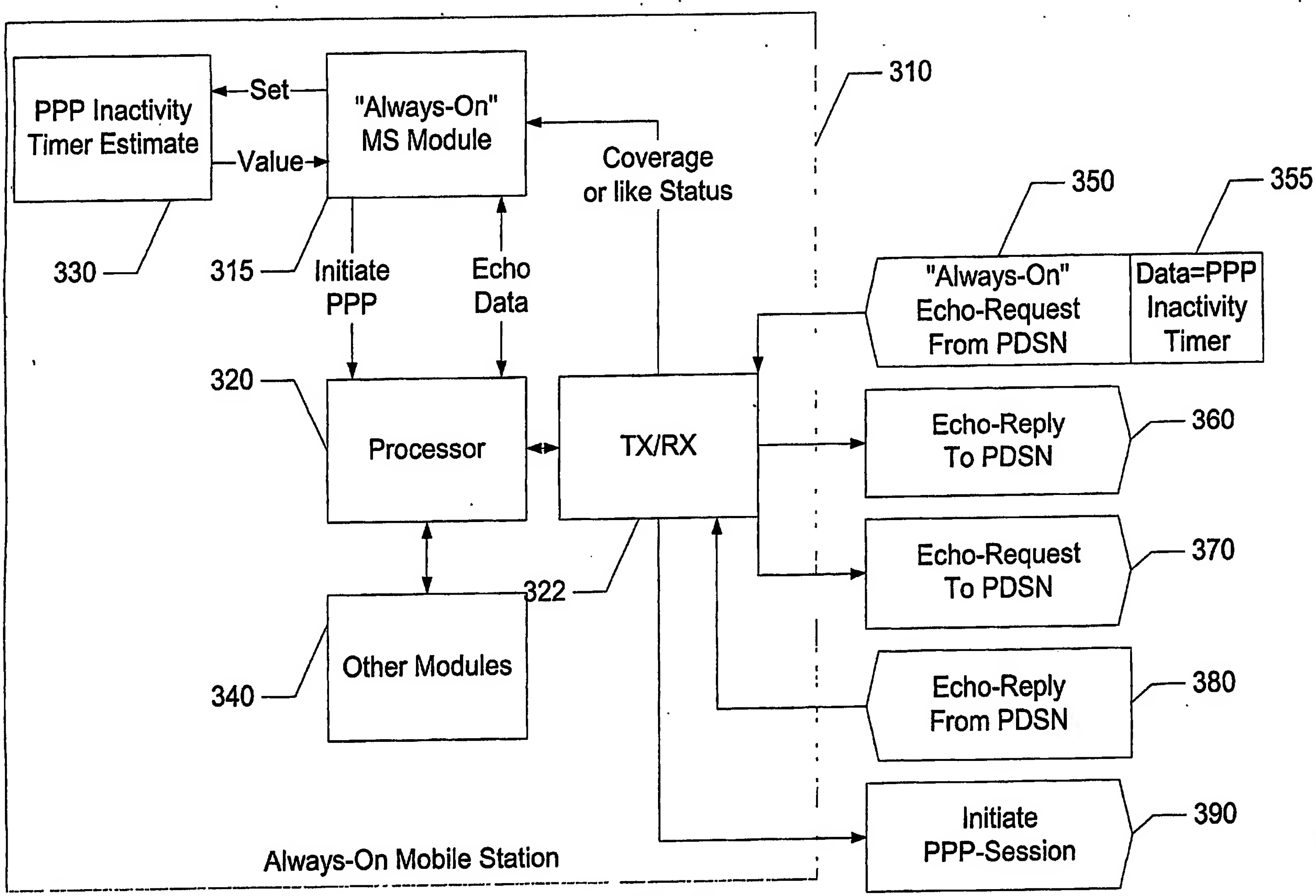
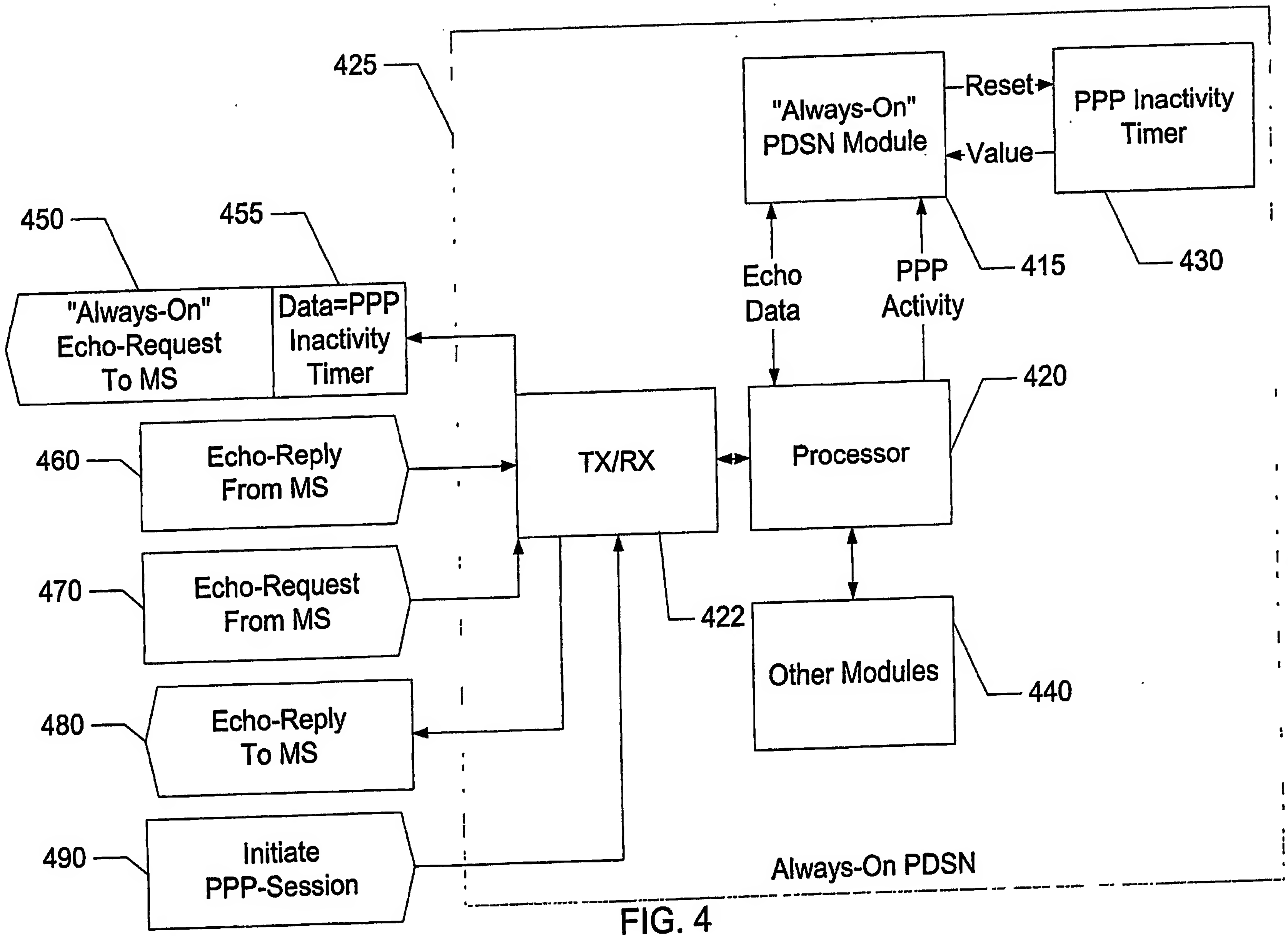


FIG. 3

60400865 .060102


425
"Always-On"
PDSN Module
Reset
Value
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Timer
415
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Echo-Request
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Inactivity
Timer
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Data
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Activity
420
TX/RX
Processor
460
Echo-Reply
From MS
470
Echo-Request
From MS
422
Other Modules
440
480
Echo-Reply
To MS
490
Initiate
PPP-Session
Always-On PDSN

FIG. 4

FIG. 5

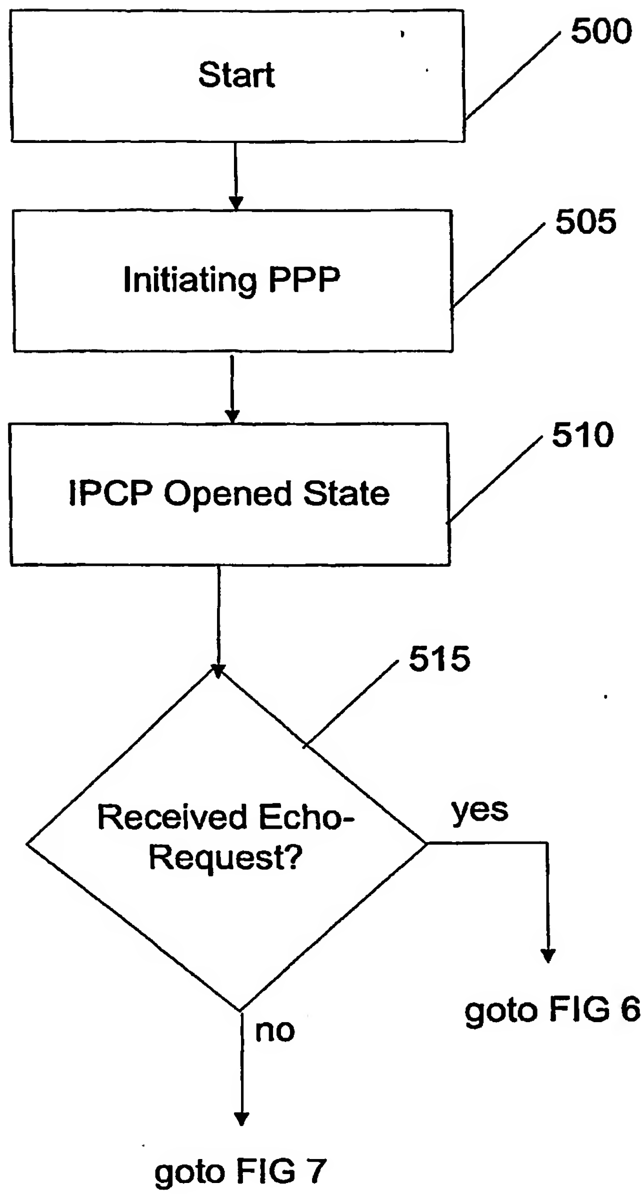

Start
500
Initiating PPP
505
IPCP Opened State
510
515
Received Echo-Request?
yes
no
goto FIG 6
goto FIG 7

FIG. 6

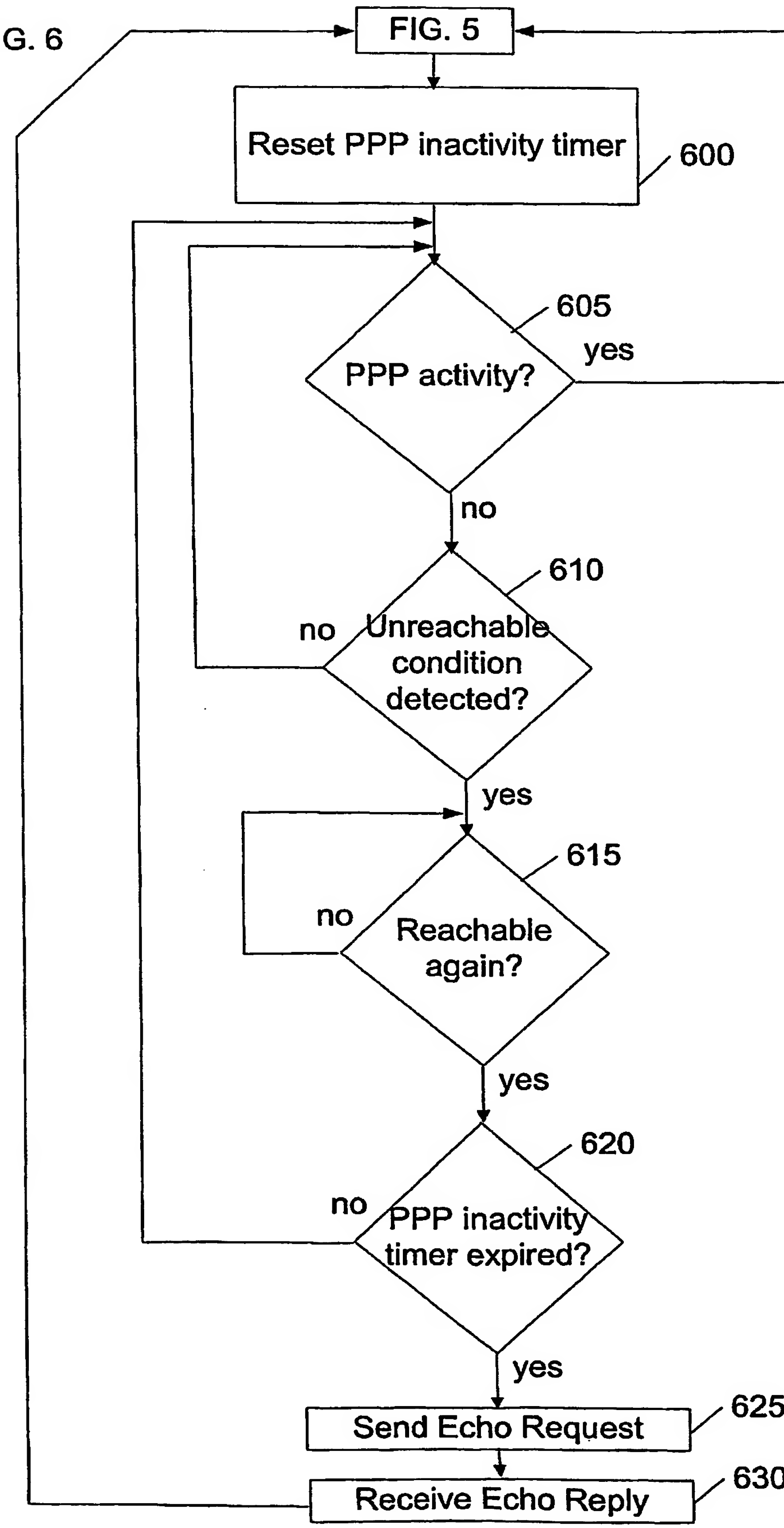


FIG. 5
Reset PPP inactivity timer
600
605
PPP activity?
yes
no
610
no
Unreachable condition detected?
yes
615
no
Reachable again?
yes
620
no
PPP inactivity timer expired?
yes
Send Echo Request
625
Receive Echo Reply
630

60400865 .080102

FIG. 7

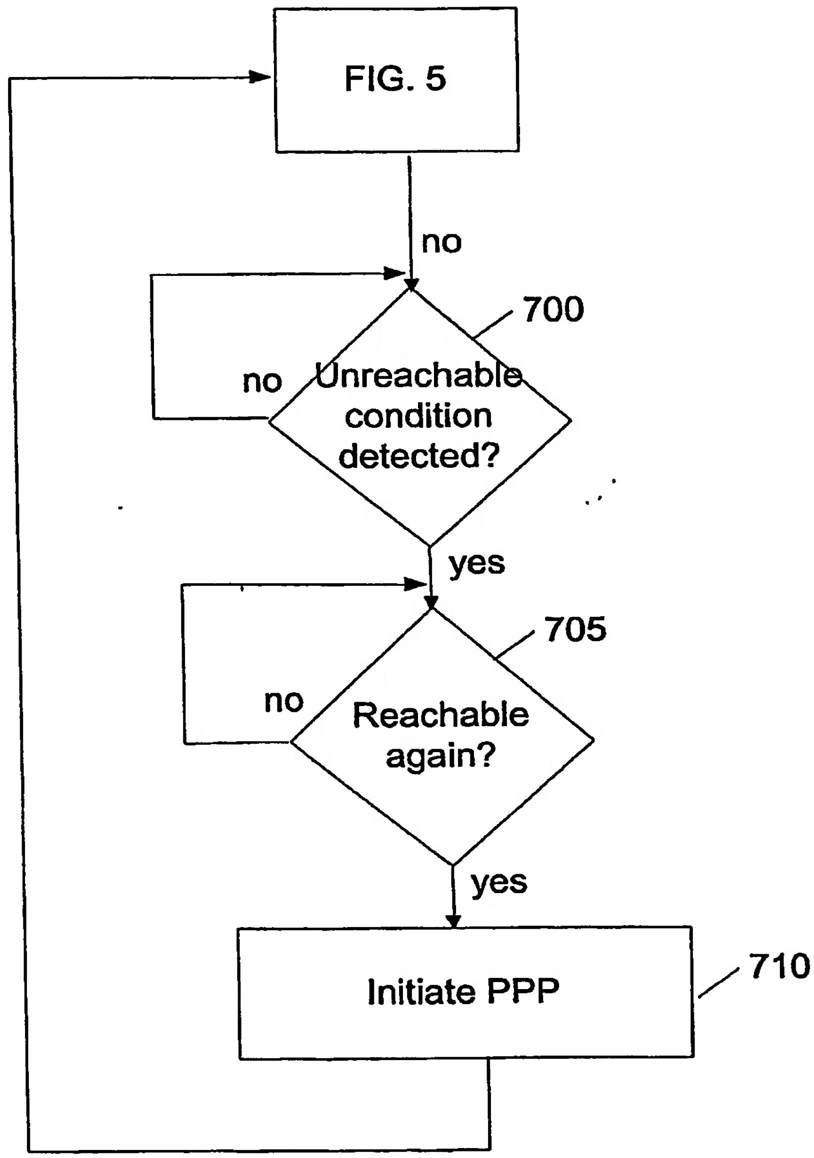
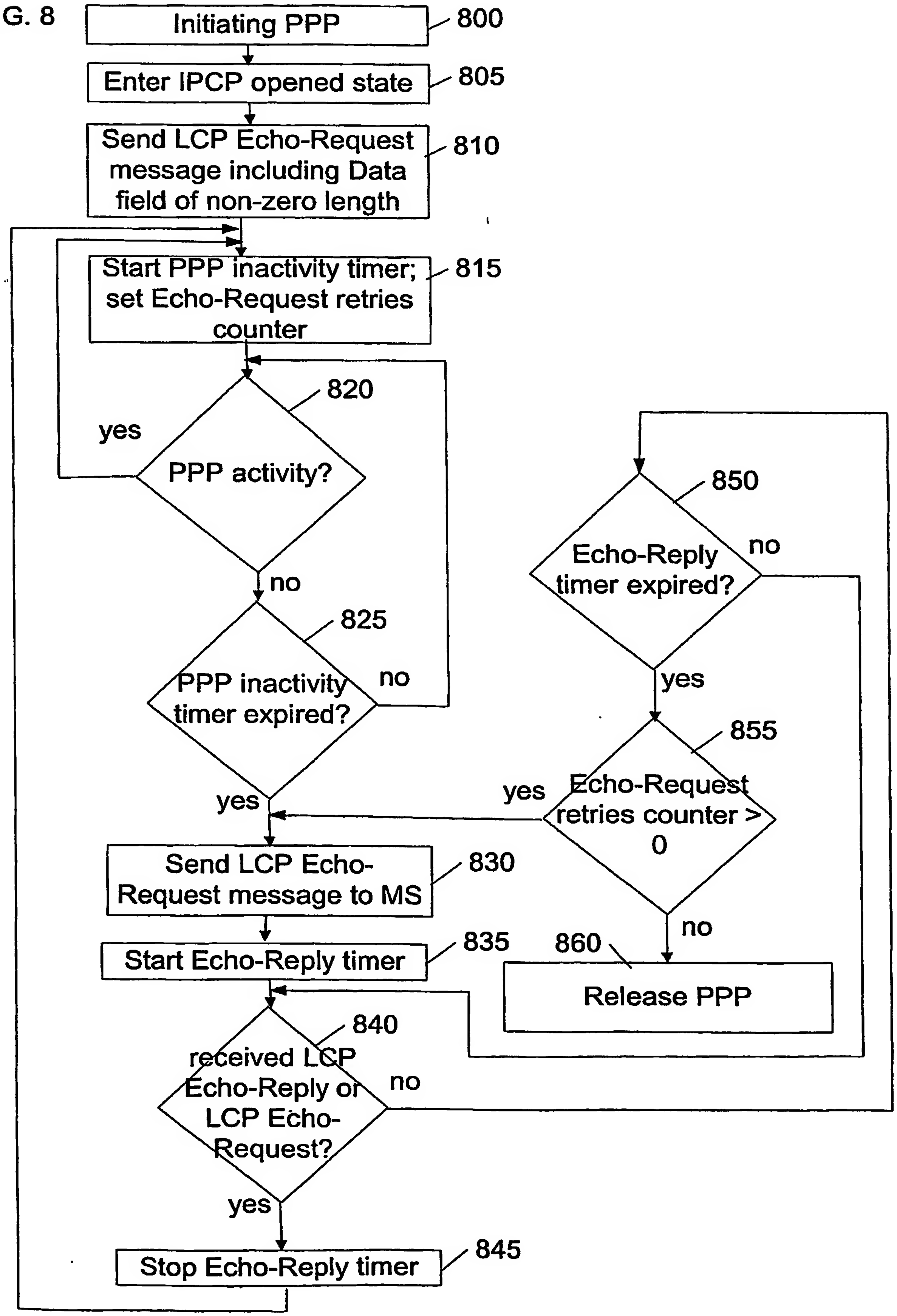


FIG. 8


Initiating PPP
800
Enter IPCP opened state
805
Send LCP Echo-Request message including Data field of non-zero length
810
Start PPP inactivity timer; set Echo-Request retries counter
815
820
yes
PPP activity?
no
825
PPP inactivity timer expired?
no
yes
Send LCP Echo-Request message to MS
830
Start Echo-Reply timer
835
840
received LCP Echo-Reply or LCP Echo-Request?
no
yes
Stop Echo-Reply timer
845
850
Echo-Reply timer expired?
no
yes
855
Echo-Request retries counter > 0
yes
no
860
Release PPP

APPENDIX

Portland, Oregon
August 2002

TR45.6/2002.08.05.10

TIA Subcommittee TR-45.6

Adjunct Wireless Packet Data Standards

TITLE: Proposed Resolution to Battery Life and Reachability issues in PN-3-4732-RV2-A (Research In Motion Ballot comment #1)

SOURCE:

Research In Motion

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ABSTRACT:

Proposes resolution to RIM's PN-3-4732-RV2-A ballot comment #1 regarding Battery Life and Reachability/Capacity issues.

RECOMMENDATION:

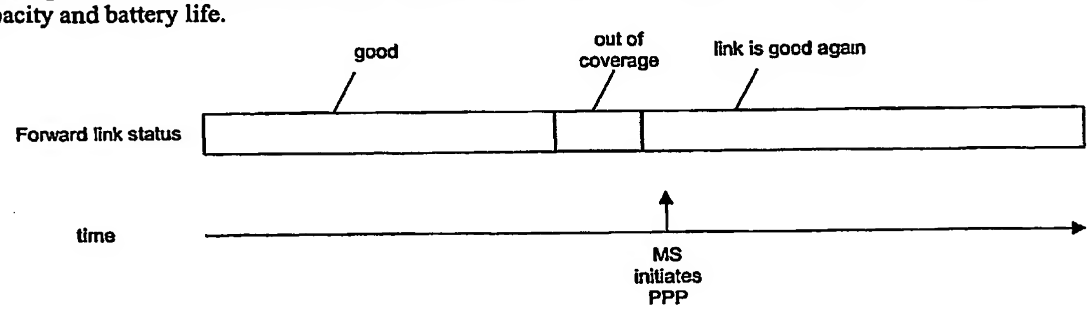
Discuss and adopt.

Notice

Appendix A

1. Introduction

The reballot text for TIA/EIA/IS-835-B has problems that result in both wasted air interface capacity and poor battery life for always-on devices.
Currently the behavior of the PDSN creates situations where the MS must initiate a PPP session in order to guarantee that there be no disruption in service. For example the below figure depicts a Simple IP case where the MS has gone out of coverage for a short time and then comes back in coverage. During the time the MS is out of coverage, the PDSN could have ended the PPP session and the MS would have no way of knowing. In order to guarantee service, the MS must initiate a PPP session, wasting both air interface capacity and battery life.

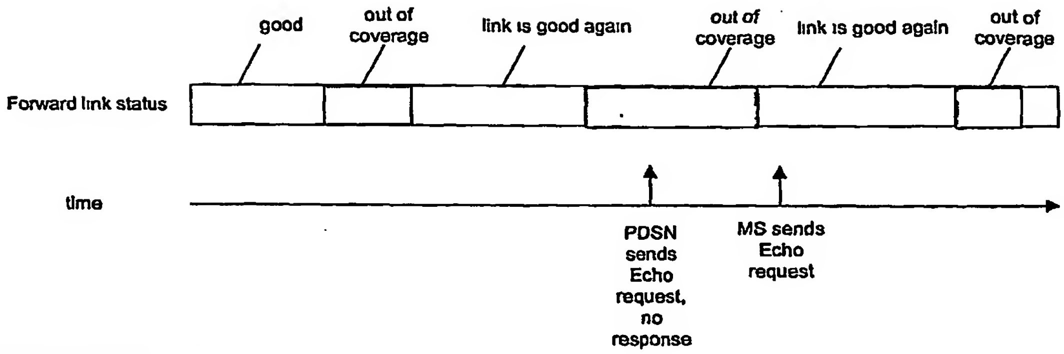


2. Recommendation

In order to resolve the issue, we recommend the following:

1. Support for always-on devices must be mandatory for the PDSN.
2. For the case of Simple IP, the MS must be informed of the value of the PPP inactivity timer.
3. The PDSN must never tear down PPP before the expiration of the PPP inactivity timer is such a way as to leave the MS unreachable. This and the value of the PPP inactivity timer will allow the MS to stop reinitiating PPP after every temporary loss of coverage.
4. In order to preserve battery life for the always-on device and to avoid wasting air interface capacity, there must be a minimum allowed PPP inactivity timer for the always-on device. We recommend a value of two hours.
5. In the Simple IP case, when the MS is out of coverage when the PPP inactivity timer expires, the MS should be allowed to send an Echo Request message when it is back in coverage.

The below figure demonstrates the benefits of the recommended changes. The figure depicts a Simple IP case where the MS goes in and out of coverage three times. The PDSN is configured to retry the Echo Request one time. After the first time the MS goes out of coverage, the PPP inactivity time has not expired and since the MS knows the time it will expire, it need not send a message, thus saving both air interface capacity and battery life. During the second time the MS is out of coverage, the PDSN inactivity timer expires. The PDSN sends the Echo request, but since the MS is out of coverage, it does not receive the response. When the MS is back in coverage, it sends an Echo request, and the PPP inactivity timer is reset. The Echo Reply Timeout timer is set such that it would have gone off during the third instance where the MS is out of coverage. If the MS had not sent the echo request, PPP would have been torn down during this third instance.



3. Proposed Changes

[…]

5 Simple IP Operation

[…]

5.2 PDSN Requirements

[…]

5.2.1 PPP Session

[…]

5.2.1.2 Termination

[…]

The PDSN may receive the Always On attribute with value '1' from the HAAA in order to activate Always On service for a user. Upon receiving the Always On attribute with value '1' from the HAAA ~~To implement Always On service for a user~~ the PDSN shall utilize the expiration of the PPP inactivity timer and the procedures described in Section 5.2.1.7 to determine if the PPP session should be closed. After receiving the Always On attribute with value '1' from the HAAA, the PDSN shall not set the PPP inactivity timer to a value shorter than two hours.

[…]

5.2.1.7 PPP Link Status Determination

~~If the PDSN supports Always On service, the~~The PDSN shall support the following configurable timer and counter:

- Echo-Reply-Timeout timer
- Echo-Request-Retries counter

Upon entering the IPCP Opened state on a PPP session configured for Always On Service, the PDSN shall send over the main service instance an LCP Echo-Request message [RFC 1661] with the Data field of the Echo-Request packet set to a two-byte field representing the value of the PPP inactivity timer in seconds, and shall start the PPP inactivity timer for the PPP session in question. Upon expiration of the PPP inactivity timer, the PDSN shall send an LCP Echo-Request message [RFC 1661] over the main service instance, and start the Echo-Reply-Timeout timer for the PPP session in question. It shall also initialize the Echo-Request-Retries counter to a configurable integer value.

Upon receipt of an LCP Echo-Reply message, an LCP Echo-Request message [RFC 1661], or any other PPP packet for the PPP session in question, the PDSN shall stop the Echo-Reply-Timeout timer, reset the Echo-Request-Retries counter, and start the PPP inactivity timer.

The PDSN shall adhere to RFC 1661 section 5.8 "Echo-Request and Echo-Reply" with regards to LCP Echo-Request message processing.

Upon expiration of the Echo-Reply-Timeout timer when the Echo-Request-Retries counter value is greater than zero, the PDSN shall send an LCP Echo-Request message, decrement the Echo-Request-Retries counter by one, and start the Echo-Reply-Timeout timer.

Upon expiration of the Echo-Reply-Timeout timer when the Echo-Request-Retries counter value is equal to zero, the PDSN shall release the PPP session.

[...]

5.4 MS Requirements

[...]

5.4.1 PPP Session

[...]

5.4.1.7 PPP Link Status Determination

To support Always On service, the MS shall adhere to RFC 1661 section 5.8 "Echo-Request and Echo-Reply" with regards to LCP Echo-Request message processing.
If the MS supports Always On service and it receives an LCP Echo-Request message with the Data field set to a two-byte nonzero value, it shall maintain an MS PPP inactivity timer based upon this value. Upon expiration of the MS PPP inactivity timer, the MS shall send over the main service instance an LCP Echo-Request message [RFC 1661].

[...]

13 Radio Network Requirements

13.1 General

The PDSN interfaces to the Radio Network only through the R-P interface and there are no RN dependent signaling messages transmitted to the PDSN. However, there are some general requirements placed on the RN:

- Each RN is connected to at least one PDSN.
- The RN relays PPP frames between the MS and PDSN.
- The RN establishes an R-P connection for each MS initiated packet data service instance. If the MS initiates multiple service instances, each R-P connection is directed to the same PDSN.
- The RN terminates the R-P connection if the MS terminates the packet data session~~ or if the RN determines that the MS is no longer reachable~~.
- The RN shall not terminate the R-P connection if it determines that the MS is not reachable (in such a situation, the MS may be temporarily out-of-coverage.)
- For some service options, the RN may buffer user data from the PDSN when radio resources are not in place or insufficient to supporth the flow of data.
- The RN passes octets between the MS and PDSN without any framing conversion.

[...]

Portland, Oregon
August 2002

TR45.6/2002.08.05.11

TIA Subcommittee TR-45.6

Adjunct Wireless Packet Data Standards

TITLE: Correction to Section 5.2.1.7 (Related to Research In Motion Ballot comment #1 on PN-3-4732-RV2-A)

SOURCE:

Research In Motion

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ABSTRACT:

Proposes removing a redundant requirement.

RECOMMENDATION:

Discuss and adopt.

Notice

Appendix B

1. Introduction

The second resetting of the Echo-Request Retries counter is redundant; it will be reset when the PPP inactivity timer expires..

2. Proposed Changes

[...]

5 Simple IP Operation

[...]

5.2 PDSN Requirements

[...]

5.2.1 PPP Session

[...]

5.2.1.7 PPP Link Status Determination

If the PDSN supports Always On service, the PDSN shall support the following configurable timer and counter:

- Echo-Reply-Timeout timer
- Echo-Request-Retries counter

Upon entering the IPCP Opened state on a PPP session configured for Always On Service, the PDSN shall start the PPP inactivity timer for the PPP session in question. Upon expiration of the PPP inactivity timer, the PDSN shall send an LCP Echo-Request message [RFC 1661] over the main service instance, and start the Echo-Reply-Timeout timer for the PPP session in question. It shall also initialize the Echo-Request-Retries counter to a configurable integer value.

Upon receipt of an LCP Echo-Reply message [RFC 1661] for the PPP session in question, the PDSN shall stop the Echo-Reply-Timeout timer~~, reset the Echo-Request-Retries counter,~~ and start the PPP inactivity timer.

Upon expiration of the Echo-Reply-Timeout timer when the Echo-Request-Retries counter value is greater than zero, the PDSN shall send an LCP Echo-Request message, decrement the Echo-Request-Retries counter by one, and start the Echo-Reply-Timeout timer.

Upon expiration of the Echo-Reply-Timeout timer when the Echo-Request-Retries counter value is equal to zero, the PDSN shall release the PPP session.